

A new Species of Enteropneusta, *Ptychodera pelsarti**, from the Abrolhos Islands. By W. J. DAKIN, D.Sc., F.L.S., Professor of Biology in the University of West Australia.

[Percy Sladen Trust Expedition to the Abrolhos Islands under the leadership of Prof. W. J. DAKIN.]

(PLATES 10 & 11.)

[Read 6th April, 1916.]

INTRODUCTION.

NOTWITHSTANDING the investigations that have been made up to date, the coast of Western Australia is almost an unknown region so far as marine biology is concerned. No Enteropneusta were known from this side of Australia—as a matter of fact, none have been recorded from the north, west, or southern coasts of the island continent. It was particularly interesting, therefore, to find a number of specimens of an Enteropneust on one of the Abrolhos Islands. The specimens were discovered by the author of the paper on the lagoon side of the Pelsart Island Reef at its southern extremity. It was originally intended to publish an account of the islands before any papers on the fauna. As the work was, however, rather of the nature of a preliminary examination, and a second expedition is intended this year, the description of the islands will be withheld until our return.

At the place where the specimens were found the coral reef is submerged at high-tide and only just uncovered at low-water. The rise and fall of the tide is only about 2-3 feet. The specimens occurred in a deposit of sand, gravel, and shell-fragments, which had collected in hollows in the smooth water-worn reef-flat. They were frequently found under small loose pieces of coral, with the anterior extremity just projecting out of the sand. About fifteen specimens were obtained by sifting the gravel between the fingers under water. They varied somewhat in size, but none could be called small, the average size being about 4 inches (10 cm.) when extended.

The specimens belong to a new species of the genus *Ptychodera*. They are not very far removed from some of the varieties of *Ptychodera flava* now known, and at first there was some doubt in my mind as to whether this new form might not better rank as a subspecies. As, however, it appears quite

* The species is named after Pelsart, whose ship was wrecked on the Abrolhos Islands in the year 1629. The island on which the specimens were found is also named after Pelsart, whose adventures at the Abrolhos Islands were of the most thrilling character.

distinct in many ways and occupies a somewhat isolated position geographically, it is better to consider it a distinct species at once.

The genus *Ptychodera* was first recorded from the Australian coast by Professor J. P. Hill in 1893—the species coming from the coast of New South Wales. This Eastern form was named *Ptychodera australiensis*. Since that time a number of new species and varieties of the genus have been recorded, and one of these was also from the East Australian coast—*Ptychodera hedleyi*.

In 1901, however, Spengel* revised the nomenclature of Enteropneusta, and as a result confined the genus *Ptychodera* to the species formerly placed in the group Chlamydothorax. As a result of this reshuffling of names, *Pt. australiensis*, Hill, became *Balanoglossus australiensis* (Hill) and *Pt. hedleyi*, Hill, became *Glossobalanus hedleyi* (Hill).

Ptychodera pelsarti, n. sp., from the Abrolhos Islands, is thus the only species of the genus so far known from Australia, although all three Australian Enteropneusta belong to the same family—the Ptychoderidæ, Spengel.

Ptychodera flava, Eschscholtz, 1825, is the oldest-known Enteropneust. The description of the original specimens from the Marshall Islands in the Pacific was, unfortunately, defective, and no Enteropneusta from this locality have since been investigated. In 1897 †, however, Willey described specimens found by him on a small islet inside the reef of New Caledonia as probably identical with *Pt. flava* of Eschscholtz, but suggested the name *Pt. caledoniensis* until the Marshall Island *Pt. flava* was re-examined. The next mention of *Pt. flava* was in Hill's Report ‡ on the Enteropneusta of Funafuti. In 1903, Spengel published a paper § on an Enteropneust from one of the Sandwich Islands—Laysan,—which resembled closely Willey's specimens of *Pt. flava* from New Caledonia. This form is described as *Pt. laysanica*. Finally, in the same year, Punnett described the Enteropneusta from the Laccadive Islands and Maldivé Islands, and regarded several forms as new varieties of *Ptychodera flava*.

The present position is, therefore, to be summed up as follows:—

<i>Ptychodera flava</i> . Type insufficiently described.	Habitat: Marshall Isles. Pacific.
<i>Pt. flava</i> , var. <i>caledoniensis</i> , or <i>Pt. caledoniensis</i> .	Habitat: New Caledonia. Pacific.
<i>Pt. flava</i> , var. <i>laysanica</i> , or <i>Pt. laysanica</i> .	Habitat: Laysan Isle. Pacific Ocean.

* "Die Benennung der Enteropneusten-Gattungen," Zool. Jahr., Syst. Abt. Bd. xv. Hft. i. 1901.

† "On *Ptychodera flava*, Eschscholtz," Q. J. M. S. vol. xl. n. s., 1897.

‡ Memoirs Australian Museum, vol. iii.

§ Zool. Jahr., Anat. Abt. Bd. xviii. 1903.

<i>Ptychodera flava</i> ,		
var. from Funafuti.	Habitat: Funafuti.	Pacific Ocean.
<i>Pt. flava</i> ,	}	Habitat: Laccadive and Maldive Isles. Indian Ocean.
var. <i>parva</i> .		
var. <i>laccadivensis</i> .		
var. <i>maldivensis</i> .		
var. <i>saxicola</i> .		
var. <i>gracilis</i> .		
var. <i>muscula</i> .		
var. <i>cooperi</i> .		
<i>Pt. pelsarti</i>	Habitat: Abrolhos Islands.	Southern Indian Ocean.

To complete the list, the remaining species of the genus *Ptychodera*, as now limited, may be added :—

<i>Ptychodera erythraea</i>	Habitat: Red Sea.
<i>Ptychodera bahamensis</i>	Habitat: Bahamas.
<i>Ptychodera viridis</i>	Habitat: Maldive Islands.
<i>Ptychodera asymmetrica</i>	

PTYCHODERA PELSARTI.

Colour, Measurements, and External Form.

Like most species of the Ptychoderidæ, *Pt. pelsarti* (Pl. 10. fig. 1) is littoral and occurs in very shallow water. Its habitat, like that of *Balanoglossus australiensis*, is loose, gravelly sand, under and around stones in sheltered pools between tide-limits.

The colour is a nearly uniform pale yellow, the hepatic cæca not being too decidedly marked by colour, but only a little darker (brownish), and this only anteriorly. The body of the animal, particularly the posterior region, is translucent, hence the contents of the alimentary canal—shell and gravel—can be quite easily seen in the living animal. The animals are somewhat delicate, and care must be taken to keep them complete while removing them from the sand.

Size.

No accurate measurements were made of the animals when alive. This is much to be regretted, because the amount of contraction taking place after fixation and preservation is extremely great. The average size of the animals captured was about 10 cm.

The size of the 10 cm. specimen after fixation is approximately 50–60 mm.

Proboscis.

The proboscis is short, and, in preserved specimens, is only equal to the width of the collar. In life the proboscis is constantly being extended, so that its length is greater than its width. The extended length, however,

was never more than twice the width of the collar. In the preserved specimens the length of the proboscis varies from 2.5 mm. to 4 mm.

Collar.

In both the living and the preserved specimens the surface of the collar can be subdivided into five characteristic regions, as in other species of *Ptychodera*. The most anterior of these regions occupies a little more than half the collar. In front it possesses a crinkled margin, surrounding the narrow neck or base of the proboscis. The diameter of the collar diminishes slightly towards the end of this anterior region, and ultimately we reach the second region—a circular groove,—which, as we shall see later, is also well-marked histologically. This groove is succeeded by a circular cushion, behind which is a deep furrow in which the epithelium forms a smaller cushion. Lastly, we come to the fifth region, which forms the posterior margin of the collar.

The total length of the collar in the preserved specimens, in which the proboscis was from 2.5–4 mm. in length, varied from 2.3–4 mm. That is to say, the collar and proboscis, in the contracted state, are almost equal in length.

Trunk.

Branchiogenital Region.—This region is characterised by the possession of genital pleura, which are attached anteriorly to the collar (Pl. 10. fig. 1). These genital wings are slightly different from those of *Pt. flava* in their point of origin. They do not arise quite so far ventrally, and in no case is there such an exposed branchial region of the alimentary canal as that figured by Willey for *Pt. flava**.

The genital pleura do not overlap, nor are they infolded. For the greater part their edges are just in contact in the median line. They remain for some distance constant in size, for a distance approximately equal to the combined lengths of the proboscis and collar. The wings are, in fact, just as large where they adjoin the collar as at any other point in this region of greatest development. A few millimetres in front of the anterior hepatic cæca the pleura commence to decrease in size. This decrease is, however, very gradual, and thus the pleura overlap the most anterior hepatic cæca. Finally, nothing is left of the genital wings but two ridges, which can be traced posteriorly for some distance at the sides of the hepatic cæca.

The Reproductive Organs occur in the pleura.

The length of the branchiogenital region is approximately 6–7 mm.

Hepatic Region.—The length of the hepatic region is about 15 mm. The sacculæ occur as paired elevations separated by a groove, the larger ones being lobulated. Their greatest development is just a little distance behind

* Willey, 'Zoological Results, based on Material' etc. part iii. 1899, plate 26.

the genital pleura. The most anterior large saccules are much darker in colour than those following, the posterior saccules being but little different in colour from the pale yellow of the body generally.

Caudal Region.—This region varies greatly in length. It is delicate and often breaks off, so that it is frequently missing in preserved specimens.

A very delicate ridge can just be traced running along the mid-dorsal line, corresponding in position to the dorsal nerve-trunk. Parallel to this, and slightly more distinct, are two ridges (one on either side of the mid-dorsal line) which are continuous anteriorly with the genital pleura. In the preserved specimens the entire animal—from the postbranchio-genital region, at least, to the end of the caudal portion is marked by close annulation.

ANATOMY.

Proboscis.

The epidermis of the proboscis (Pl. 10. fig. 2, *Epid.*) varies between .10 and .18 mm. in thickness. A conspicuous nerve-fibre layer lies at its base and is almost one-fifth to one-quarter the total thickness of the epidermis. There is a thin basement-membrane below the epidermal layer, and underlying this a conspicuous, although delicate, layer of circular muscle-fibres, which reaches its greatest development towards the base of the proboscis (Pl. 10. fig. 2, & Pl. 11. fig. 5). Between the nerve and circular muscle-layers is a prominent system of blood-lacunæ—the vascular network of the proboscis.

The Longitudinal Muscle Fibres of the proboscis are arranged, as is usually the case, in radial bundles (fig. 5, *Rad.M.*), which extend distally to the end of the glomerulus and are marked out by radial fibres. These bundles touch as they near the centre of the proboscis. At about the level of the glomerulus the longitudinal muscle-fibres encroach upon this central organ. More proximally, however, the muscles leave a space—the proboscis cœlom (figs. 2 & 5, *Pr.Co.*)—which surrounds the stomochord, glomerulus, etc., the organs forming the central complex of the proboscis (figs. 2, 4, & 5). This proboscis cœlom becomes divided dorsally, and towards the neck of the proboscis, into two pouches, which lie to right and left of the middle line (fig. 5, *Dor.P.C.*). As in other Ptychoderidæ the division is due to the presence of the pericardium (fig. 5, *Per.*). The two halves of the proboscis cœlom so formed dorsal to the central complex open generally to the exterior at the base of the proboscis by two dorsal and equal proboscis-pores (Pl. 11. figs. 8 & 9, *P.p.*).

The ventral portion of the proboscis cœlom is continued posteriorly into a kind of cœcum (fig. 2, *V.p.c.*), which also becomes separated into right and left halves—in this case by a septum, which becomes more distinct and better developed as one passes posteriorly (figs. 6 & 8, *V.p.s.*). Both the anterior and posterior edges of this septum are free, so that transverse sections through the extreme end of the ventral proboscis cœcum show no septum.

The splanchnic epithelium of the proboscis cœlom is not everywhere distinct, but it becomes particularly definite in the ventral cœcum referred to above. This is an outstanding feature of all sections through this structure. The cells are very regular in appearance and columnar or often cubical, with large nuclei which stain intensely. The ventral cœcum projects, of course, into the buccal cavity, where it appears as a small but very distinct protuberance. It is the structure which was named the "blumenkohlähnliches Organ" by Spengel, on account of its lobose appearance in *Ptychodera erythroa*. Willey termed it the Racemose Region, and in several varieties of *Ptychodera flava* it appears to possess some few small round elevations. Such is not the case in *Pt. pelsarti*—at least, in the specimens examined. The epithelium of the buccal cavity is also modified where it covers this organ, making it still more conspicuous in sections. One characteristic feature of the ventral proboscis cœcum (and consequently of the so-called Racemose Organ) of *Pt. pelsarti* is that it is very much compressed laterally (fig. 8), the septum itself consisting merely of two layers of epithelium (Splanchnotheca) with a most delicate layer of tissue and blood-spaces between them. The total thickness of the septum is only .03 mm. The relation of the nuchal skeleton to the ventral proboscis cœcum is another feature of some importance, and will be referred to below. The anterior border of the ventral septum runs obliquely backwards from the central complex.

Proboscis pores.

There are two proboscis pores, as in *Ptychodera flava* varieties, opening one on either side of the middle line. Willey states (1891) that *Pt. flava* is characterised by the *constant* occurrence of paired proboscis pores, although considerable variation seems to exist in the manner of communication between the pores and the proboscis cœlom. Six variations were described, but in all cases there were two pores—two actual openings.

The proboscis pores open into terminal ectodermal vesicles, which are connected by tubes with the dorsal cœlomic canals. Now, in *Pt. pelsarti*, as in *Pt. flava*, the proboscis pore is a wide orifice almost equal in diameter to the terminal vesicle itself (Pl. 11. figs. 8 & 9, *V.p.p.*). In two specimens examined by serial sections there was some variation in the cœlomic canals.

In specimen A two proboscis pores were to be seen, one of which communicated with the cœlom directly. The other pore also opened into a terminal vesicle, but this was not in communication with its corresponding dorsal cœlomic canal. The two cavities were separated by chondroid tissue (fig. 9). This condition is somewhat like that of Series II. of Willey.

In specimen B, both sides of the animal were similar, the dorsal cœlomic canals running without any block into terminal vesicles, which opened by proboscis pores to the exterior.

Further variations are probably to be found, but I am unwilling to sacrifice the few remaining specimens for the purpose of following this out. It appears to be of little systematic importance.

Punnett also finds variations in connection with the proboscis pores in the varieties of *Ptychodera flava*, captured at the Maldive and Laccadive Islands. There may be two pores, both in communication by canals with dorsal coelomic pouches; there may be only one pore in open communication with the coelom, although the two pores are present; there may be only one proboscis pore. The side of the animal—right or left,—marked by the different conditions, varies just as much. Evidently every possible condition may occur.

Stomochord.

In *Pt. flava*, according to Willey, the Pericardium, Glomerulus, and Stomochord are *exactly co-extensive*. Unfortunately, no longitudinal sections are figured showing this. In *Pt. pelsarti* the pericardium and stomochord are co-extensive, but the glomerulus extends over both, forming a kind of cap to the "central complex" of the proboscis (Pl. 10. fig. 2, *glom.*). The stomochord (fig. 2, *St.*) may be divided into three regions:—(a) anterior interglomerular region, (b) middle or cæcal region, (c) the posterior nuchal region.

The anterior portion of the structure (see fig. 2) is without any lumen whatever. The latter becomes evident a little distance anterior to the ventral septum of the proboscis, but there are isolated traces of it in front of this. The stomochord is almost circular in section at its distal extremity. More posteriorly it becomes elliptical in section, with the long axis directed dorso-ventrally (fig. 4, *St.*). This leads next to the cæcal region, where the stomochord becomes wider transversely than dorso-ventrally (Pl. 10. fig. 6, *St.*). Two very well-developed lateral pouches are given off at this point.

In sections, the central lumen of the cord may be seen quite close to the dorsal wall of the stomochord, whilst laterally two very well-marked lateral diverticula are evident (fig. 6, *St.p.*). It cannot be said that any ventral "Blindsack" of Spengel is present at all in this form. Two well-marked lateral projections of the cord are quite as distinct as the lateral pouches in *Glossobalanus ruficollis*, *Spengelia*, and *Balanoglossus australiensis*. No ventral blind sac is to be seen. The lumen of the stomochord extends distally for some distance after the lateral pouches are given off. Posteriorly to the ventral diverticula, the stomochord loses its chorda-like character. The lumen becomes larger and larger (Pl. 11. fig. 8, *St.c.*). In transverse section the structure is almost quadrangular in shape, and numerous gland-cells appear on all sides. Finally, as the opening of the stomochord into the throat-cavity is approached, the cord becomes very much compressed dorso-ventrally and drawn out laterally, until it becomes almost as wide as it is in the region of the lateral diverticula. The cells of the ventral wall become

quite short and columnar-epithelial like. Eventually these become exceedingly small, so that their depth is only a fraction of the thickness of the dorsal wall of the cord. The attainment of this condition marks the point where the wall of the stomochord is continuous with the epithelium of the anterior end of the pharynx (Pl. 10. fig. 2, *St.o.*).

Nuchal Skeleton.

The nuchal skeleton is well developed in *Pt. pelsarti* and bears characters which are of diagnostic importance. It consists of cupule, body, keel, and cornua.

In *Pt. flava*, the cupule is figured by Willey as embracing the posterior end of the ventral dilatation of the stomochord. In the Abrolhos species, the anterior margin of the cupule is transversely expanded, and embraces the lateral pouches of the stomochord (Pl. 10. fig. 6, *Sk.l.*). Proximally to this, the cupule passes into the anterior part of the body. The latter, at this point, is only slightly compressed, and there is no crest projecting into the stomochord, although a slight convexity towards this structure may be noted.

In some species of the Ptychoderidæ a ventral keel is present, and at the anterior end this is separated from the body proper by a thin band of chondroid tissue. Willey, describing *Pt. flava*, states that no keel is present in that species, and that in this respect *Pt. flava* resembles *Pt. erythroa*, where the place of the keel is occupied by the large ventral cæcum of the proboscis cœlom, against which the body of the skeleton expands. Punnett both describes and figures a keel on certain of his varieties of *Pt. flava*, without referring to this noteworthy difference from Willey's description. Either Willey considered that the structure to be discussed below, which resembles the "keel" of Punnett's description, was not really the keel, or else Willey's *Pt. flava* was considerably different from Punnett's varieties of that species.

In *Pt. pelsarti* a keel-like ventral ridge is present on the nuchal skeleton. Anteriorly this is separated from the main part of the body by chondroid tissue—but it would, perhaps, be better to say that at this point the compact substance of the skeleton passes into a transverse band of chondroid tissue.

Slightly posterior to the commencement of the keel, two well-developed wings (Pl. 11. fig. 8, *Sk.'*) appear as lateral projections, and extend outwards on each side for some distance, eventually passing into the basement-membrane which underlies the nerve-layer of the proboscis neck at this point. The figures explain this better perhaps than is possible in a written description. Ventral to the wings of the skeleton the keel is compressed (fig. 8), and hollowed slightly to receive the ventral cæcum of the proboscis, which is strongly compressed, as we have seen above. The keel clasps this cæcum, its ventral processes gradually thinning out (fig. 8, *Sk.''*) and passing into

the basement-membrane, which underlies the small-celled epithelium of the so-called racemose organ.

A horizontal section taken through the neck of the proboscis in the region just described (Pl. 11. fig. 8) shows some of the characteristic features of the species.

Posterior to the region described above, the keel separates from the ventral proboscis cæcum, and at the same time loses its concavity and the clasping ventral margins (fig. 7). The lateral edges run out into chondroid tissue. Passing still further in a posterior direction, we find that the skeleton becomes more and more elongated in a lateral direction, still keeping a ventral keel, until finally this disappears and the transversely elongated skeleton diverges into the two posterior limbs—the cornua.

The cornua commence rapidly to diverge and embrace the œsophagus. Now it is characteristic of the Ptychoderidæ that the cornua of the nuchal skeleton terminate in front of the middle region of the collar, and in most species they do not pass back very far. In Punnett's varieties of *Ptychodera flava* the cornua only extend one-seventh to one-fourth the length of the collar, except in one variety, *Pt. flava*, var. *cooperi*, Punnett, where they attain such an extraordinary length that they approximate the posterior end of the collar. In *Pt. pelsarti* the cornua (fig. 10, *Sk.*') extend more than halfway down the length of the collar, and embrace the œsophagus to such an extent that near their terminations they are much nearer the mid-ventral line than the dorsal surface (fig. 10). This is quite a characteristic feature of the species. Apart from the great length of the cornua in Punnett's variety, there is but little resemblance between that form and *Pt. pelsarti*.

Chondroid Tissue of the Nuchal Skeleton.

The cartilage-like chondroid tissue, referred to at great length by Spengel in his well-known monograph, is well developed in the present species. It is impossible, however, to my mind, to speak of it apart from the skeleton—or to figure the skeleton as an isolated structure, as is sometimes attempted. There is no definite line of demarcation, in the best sections, between the chondroid tissue and the substance of the main mass of the nuchal skeleton (fig. 8, *Sk.* & *Ch.T.*).

Furthermore, the skeletal substance passes quite insensibly into the basement-membrane, and it is evident that in the nuchal skeleton we have a structure which is a local development of a tissue of wider extent. The fact that in some species of Enteropneusta, i. e. *Balanoglossus clavigerus*, there are numerous small cells scattered throughout the skeleton still further emphasises the point that the chondroid tissue is merely an extension of the substance of the skeleton.

In a transverse section, taken at about the plane of the proboscis pores, the chondroid tissue extends almost completely round the central blood-sinus

of the proboscis (Pl. 11. fig. 8, *Ch.T.*), and sometimes the canal leading to one of the proboscis pores is missing for a space, the chondroid tissue taking its place (fig. 9, *Ch.T.*).

The chondroid tissue when highly magnified is distinctly fibrous. With hæmatoxylin and eosin it often stains like the blood in the central blood-sinus. Its structure differentiates it at once. Every here and there are cavities, in which lie small fusiform nucleated cells. It is assumed by Spengel and Willey that the cells of the chondroid tissue arise chiefly from the epithelium of the dorsal cœlomic canals. This is probably the case, but the cells found enclosed in the chondroid tissue are, to my mind, part of the tissue itself, and responsible for its production.

Vascular System.

Proboscis glomerulus.—The glomerulus, like that of *Glossobalanus minutus* and *Balanoglossus australiensis*, extends over, and forms a cap to, the pericardium and the stomochord (Pl. 10. fig. 2). Posterior to the end of the stomochord, the glomerulus becomes restricted to two lateral masses lying one on either side of the central complex of the proboscis (fig. 4, *rad.glom.*). The cells of the splanchnotheca are easily recognised, covering the glomerulus distally (fig. 4, *Spl.*). There is little to add in the way of details. The general arrangement of the blood-spaces is similar to that already described in other Ptychoderidæ. The efferent proboscis vessels (figs. 5 & 8, *Eff.V.*) cannot be recognised anteriorly to the proximal end of the glomerulus. They are not only in connection with each other by blood-spaces situated in the chondroid tissue, between the body and keel of the proboscis skeleton, but they enter into communication with the capillary network of the proboscis. This condition was first described by Hill in *Balanoglossus australiensis*. It is probably to be met with in other species of the Ptychoderidæ.

Pericardium.

The pericardium (Pl. 10. figs. 2 & 4, Pl. 11. figs. 5 & 9, *Per.*) has the same essential structure as in the other described species of *Ptychodera*. It extends anteriorly just as far as the stomochord. Dorsally it is connected to the integument for some distance, thus forming a dorsal hollow septum in the proboscis (fig. 5). This contact with the integument of the proboscis ends at about the plane of the lateral cæca of the stomochord. The ventral wall of the heart-bladder is convex, owing to the space underlying it being occupied by the central blood-sinus (figs. 2, 4, 5, & 8, *C.b.s.*). There is, however, no infolding of the pericardium as in *Balanoglossus australiensis*. The cavity of the pericardium is almost filled with cellular tissue which extends right to the distal end of this organ. There is practically no difference in the appearance of this cellular tissue throughout the pericardium. The same transverse

fibres (Pl. 11. fig. 9) which have been noticed by previous observers in other species of Enteropneusta occur at the posterior end of the organ.

Nervous System.

As is well known the nervous system of the Enteropneusta consists of a nerve-fibre layer present in relation with ectodermal epithelium. In certain places this layer is very much thickened, giving rise to so-called nerve-trunks or nerve-cords. The general structure of the nervous system of *Pt. pelsarti* agrees with that of described species, and so reference will only be made here to points of systematic importance.

The most important nerve-trunk is the Collar Nerve-Cord. This cord, in the genus *Ptychodera*, is frequently a true medullary tube (*Pt. flava*) possessing a central canal opening to the exterior at both anterior and posterior ends. In some cases only a few cavities are to be seen (*Glossobalanus minuta*, *Balanoglossus australiensis*, etc.). In the species now being described there is a well-developed continuous canal (Pl. 10. fig. 2, *Can.N.C.*) with anterior and posterior neuropores (fig. 2, *Ant.N.P.* and *Post.N.P.*). This appears to be characteristic of all members of the genus *Ptychodera*, although Punnet found a marked tendency to occlusion of the canal in many specimens of his varieties of *Pt. flava*. There is no tendency towards occlusion in any of the specimens of *Pt. pelsarti* examined.

In transverse section the cord is everywhere much broader than deep (dorso-ventral measurement) (Pl. 11. fig. 10).

The nerve-substance is almost confined to the ventral side of the tube (fig. 2, *D.N.C.*). It is much more thin laterally, and dorsally can only just be recognised. In fact, the dorsal and ventral walls of the collar nerve-cord are entirely different. The cells of the dorsal wall are very delicate, and not nearly so numerous as the cells of the ventral wall. The ventral wall agrees much more with the external epithelial layer of the proboscis, particularly with that of the anterior neuropore region. It is true that gland-cells are not so numerous, but they are present in very considerable numbers, and quantities of mucus may be found in the lumen of the nerve-trunk. There are very few gland-cells amidst the cells of the dorsal wall, except in the posterior region of the collar, where they become slightly more numerous. There are no traces of giant ganglion cells.

As in other species of *Ptychodera*, the collar nerve-trunk is united with the epidermis at intervals by unpaired dorsal roots (fig. 2, *D.R.*^I, *D.R.*^{II}). These are few in number, three roots being most common. The anterior root arises in front of the middle point of the cord, almost in the same plane as the opening of the stomach into the throat-cavity (fig. 2). This agrees with Hill's description of *Balanoglossus australiensis*, and is contrary to Spengel. The roots arise as hollow diverticula from the medullary tube and run

obliquely backwards. A lumen may be traced for quite a distance—at least, in the most anterior roots. The histological structure is practically the same as that of the dorsal wall of the nerve-cord.

Collar Epidermis.

The collar epidermis is divisible, as in other species of *Ptychodera*, into five zones (Pl. 10. fig. 2). The extent of these has been previously noticed. It will suffice here to mention that the second, third, and fourth zones are somewhat similarly constituted, and in section stain darkly with hæmatoxylin owing to the numerous gland-cells present. The fourth zone of the collar is, however, the most markedly glandular region of the animal's epidermis and stains very intensely with hæmatoxylin. The fifth region is very free from dark staining cells.

Collar Cœlom.

The cavity in the anterior half of the collar is reduced, a considerable amount of connective tissue being present between the outer epidermal muscle-layers and those underlying the wall of the alimentary tract (fig. 2, *C.tis.*). Behind the anterior region there are numerous transverse muscle-fibres arranged in radial bundles (Pl. 11. fig. 10, *R.mus.*), and the cavity—collar cœlom—is thus split up somewhat.

A well-developed dorsal septum is present, in the specimen examined, posterior to the second root of the collar nerve-cord (fig. 10, *D.Sept.*). On the ventral side of the collar a longitudinal space is present, into which project folds with vessels belonging to the ventral vascular plexus (fig. 10, *V.plex.*). No ventral septum appears to be present.

Collar Canals.

The collar canals have the same characters as those of many other described species of the Ptychoderidæ, i. e. *Pt. flava*, *Glossobalanus minuta*, *Balanoglossus australiensis*, etc.

Branchio-genital Region.

Reference need only be made to a few points here, for the general structure is in agreement with that of the other known species of *Ptychodera*. The gonads extend forwards in the genital pleura up to the most anterior gill-clefts. The pleura are well developed and arise somewhat deeply, but certainly not so far ventrally as is the case in some other species of *Ptychodera*. There is, moreover, a very striking difference between transverse sections of *Pt. flava* (and apparently its varieties) and *Pt. pelsarti*, the sections being taken through the branchio-genital region in each case. The difference lies in the relative area of the branchial and œsophageal divisions of the pharynx. In *Pt. flava* the branchial region predominates over the

oesophageal. In *Pt. bahamensis* both divisions are nearly equal in area. In *Pt. erythroa* the branchial region is the smaller of the two, and this is the condition in *Ptychodera pelsarti*. The two cavities are not separated quite as distinctly in the latter species as in the others named here. There is no great constriction separating the two regions, which are consequently open to each other by a rather wide channel. The line of demarcation between the bases of the gills and the oesophageal epithelium is, as usual, marked by longitudinal parabranial ridges. They consist of epithelial cells which are twice or more than twice as deep as the cells lining the rest of the oesophageal division of the pharynx.

The lateral septa of the genital pleura (Pl. 11. fig. 11) bearing blood-vessels, and connecting the gonads, arise as described by Willey in *Pt. flava*. They are co-extensive with the genital pleura, and arise from the basement-membrane close to the base of the gill-clefts. They are inserted into the same basement-membrane near the free margin of the pleura. Behind the pharynx there still seems to be some doubt as to the point of origin of the lateral septa—Punnett and Spengel disagree with Willey. It has not been possible to settle this question definitely from the slides at present at my disposal.

The gonads, as in *Pt. flava*, are met so far anteriorly that they occur in the same transverse sections as the collar canals. In other respects the reproductive organs agree very closely with those of the other species of the genus *Ptychodera*.

Posterior to the gill-region the much reduced genital pleura encroach on the hepatic region.

Hepatic Region.

The Hepatic Region is similar in structure to that of other species of the genus.

The epithelial wall of the alimentary canal is thrown into folds of considerable irregularity, so that in transverse sections one meets "islands" of "wall" on all sides.

Two longitudinal grooves are present dorso-laterally, as in *B. australiensis*, *Pt. flava*, and *Gl. hedleyi*.

The genital pleura can be traced into the hepatic region as very low elevations just above the longitudinal grooves, a condition similar to that described by Hill for *B. australiensis*.

Caudal Region.

Since Willey invented the term Pygochord for the ventral structure first described by Spengel as a "Kielförmiger Fortsatz" of the intestinal epithelium, some little discussion has arisen concerning this feature. Willey

states that it commences as "a simple thickening of the ventral wall of the hind gut, which is soon drawn out into a flattened band with dilated distal (ventral) border."

In *Pt. pelsarti* a pygochord is present, and consists, for the greater part, of a band of tissue running from below the gut-epithelium in the mid-ventral line to the basement-membrane of the integument. The tissue is cellular with oval nuclei, and on each side of it is basement-membrane. The structure certainly seems too delicate to be of much service as a support, although it may possibly serve as a kind of mesentery. There is no evidence in the species examined either in favour of or against Punnett's ingenious suggestion that the pygochord may be the remains of a ventral siphon now vestigial.

SUMMARY.

It will be advisable perhaps to add, in the form of a summary, a short diagnosis of the characters of the species *Ptychodera pelsarti*.

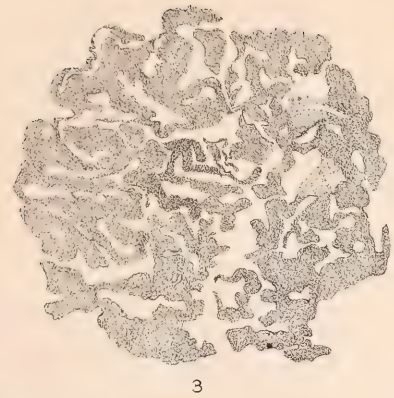
PTYCHODERA PELSARTI, n. sp.—Moderately large form, average size of preserved specimens 50–60 mm. (considerable contraction had taken place). Proboscis cavity with longitudinal muscles gathered into distinct radially arranged bundles. Neck of proboscis with a distinct well-developed but unlobulated "racemose" organ. Ventral proboscis, cæcum, and "racemose" organ compressed laterally. Cornua of nuchal skeleton very long and reaching posterior half of collar, body of skeleton with characteristic shape. Two proboscis pores. Stomochord with well-developed lateral pouches. Œsophageal region of pharynx predominates over the branchial. Collar nerve-cord with continuous lumen and usually with three dorsal roots. Locality: Pelsart Island, Abrolhos Islands, West Coast of Australia.

EXPLANATION OF PLATES 10 & 11.

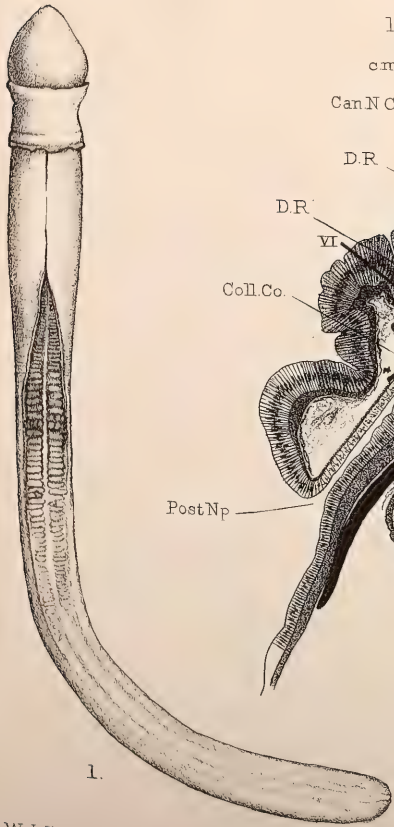
Reference letters.

(Figures 1–4, 6 are on Plate 10; figures 5, 7–12 on Plate 11.)

- Ant.Np.* Anterior neuropore. Fig. 2.
Br. Branchial bar. Fig. 11.
Br.c. Branchial region of alimentary canal. Fig. 11.
C.b.s. Central blood-sinus of proboscis. Figs. 2, 4, 5, 8, & 9.
c.m.c. Circ. muscle-fibres of collar. Fig. 2.
C.tis. Connective tissue of collar. Figs. 2 & 10.
Can.N.C. Canal of dorsal nerve-cord. Figs. 2 & 10.
Ch.T. Chondroid tissue. Figs. 7, 8, & 9.
Coll.Co. Collar cœlom. Figs. 2 & 10.
D.C.c. Dorsal cœlomic canal of proboscis. Figs. 2, 5, & 9.
D.N.C. Dorsal nerve-cord. Figs. 2 & 10.

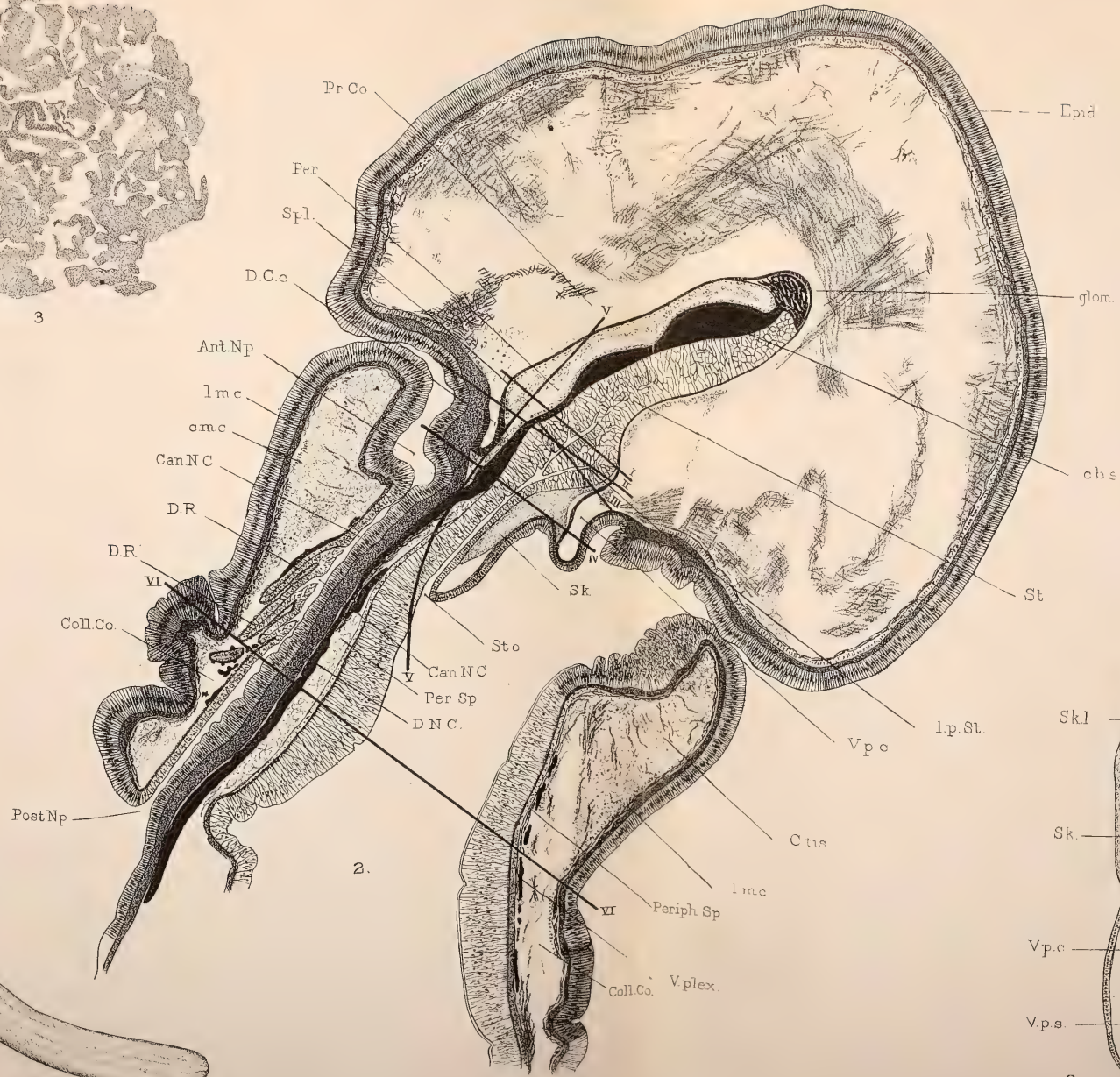


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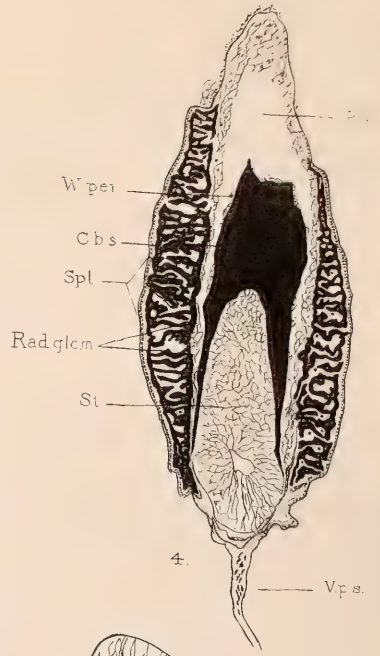


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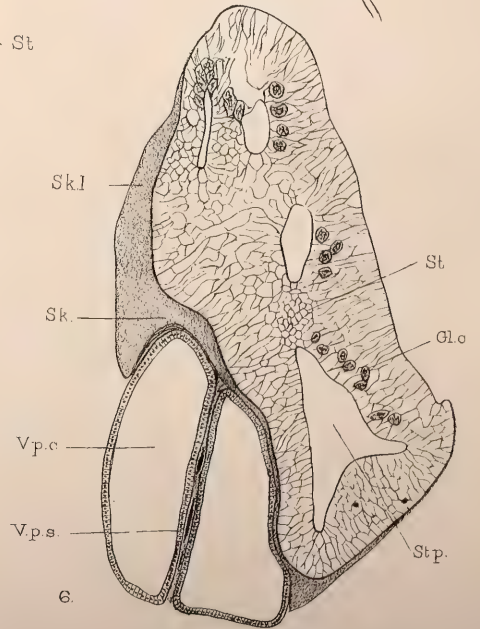
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2.



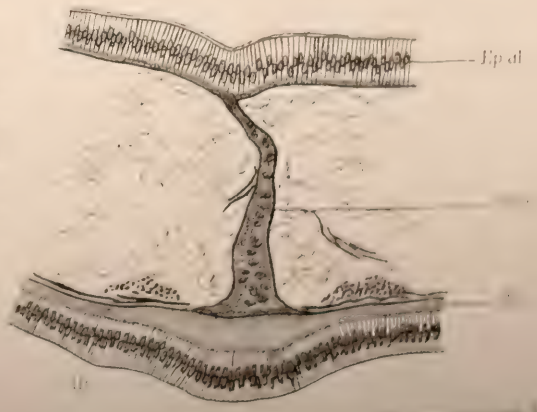
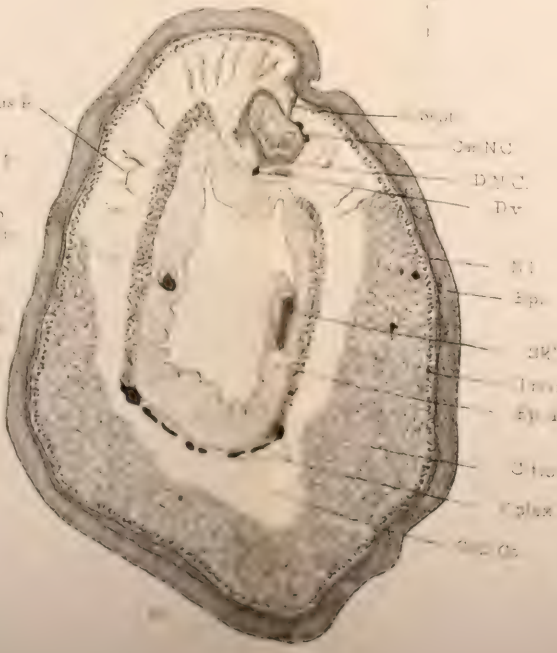
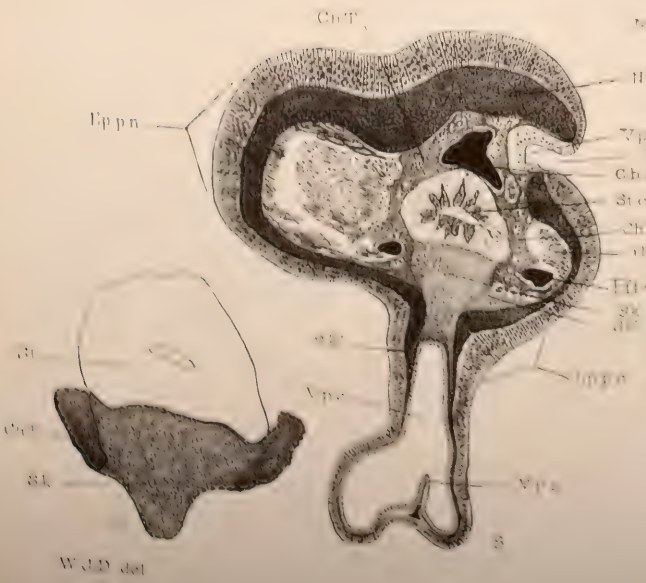
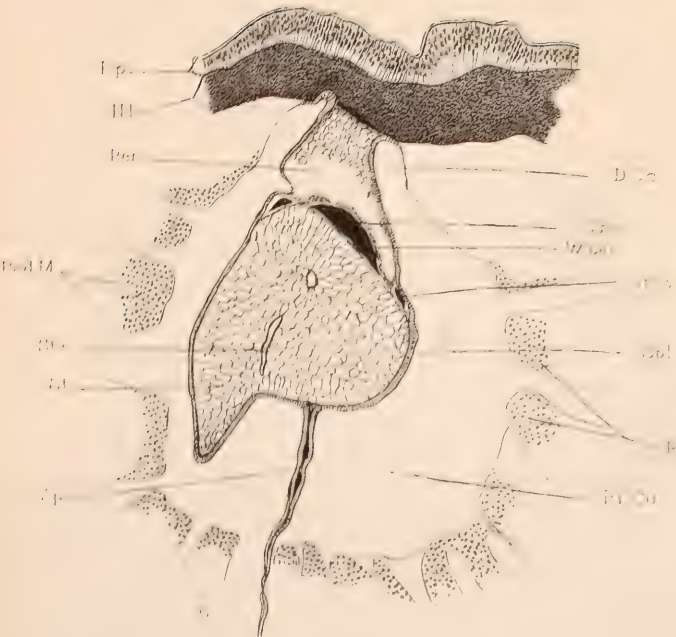
4.



6.

C.Hodges & Son. Lith. Lon.

PTYCHODEPA PELSARTI



W. J. D. del.